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Gastric Bypass Surgery in Severely Obese Women With Type 1 Diabetes: Anthropometric and Cardiometabolic Effects at 1 and 5 Years Postsurgery

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While the benefits of gastric bypass (GB) surgery in type 2 diabetes are well established, few studies have evaluated the long-term effects of GB in patients with type 1 diabetes (1,2), and these studies demonstrate conflicting effects on glycemic control. This is clinically important given the increasing prevalence of obesity in patients with type 1 diabetes (3). We studied 10 severely obese women with confirmed type 1 diabetes, as previously described (4), and evaluated outcomes prior to GB and at 1 and 5 years following surgery. Mean age at GB was 39.6 ± 8.4 years, mean duration of type 1 diabetes 24.6 ± 10.1 years, and mean age at diagnosis 16.0 ± 8.3 years. Six subjects used continuous subcutaneous insulin infusion.

BMI decreased by 33% from baseline at 1 year postoperatively (from 43.5 ± 7.5 to 29.3 ± 5.4 kg/m², $P < 0.0001$) but increased by a mean of 15% (to 33.8 ± 7.5 kg/m², $P < 0.01$) from 1 to 5 years (Table 1). Compared with baseline, HbA_{1c} was unchanged at 1 year (baseline $8.1 \pm 1.3\%$ [65 ± 14.2 mmol/mol] to 1 year $8.3 \pm 1.4\%$ [67 ± 15.3 mmol/mol], $P = 0.47$). Interestingly, HbA_{1c} trended upward at 5 years postoperatively to $9.8 \pm 1.9\%$ (84 ± 20.8 mmol/mol, $P = 0.15$). Basal insulin requirements decreased from 53.0 ± 29.7 to 23.0 ± 15.6 units/day ($P = 0.0005$) at 1 year postoperatively

but trended up from 1 to 5 years to 31.1 ± 22.8 units/day ($P = 0.17$). The trend held even when accounting for body weight. There was a robust correlation between change in insulin dose and weight ($r = 0.66$; $P = 0.04$).

Cardiometabolic risk factor assessment showed decreases in plasma triglycerides (28% decrease, $P = 0.004$) and systolic blood pressure (mean decrease of 11 ± 8.3 mmHg, $P = 0.003$) at 1 year; however, these decreases were not sustained at 5 years. There was no significant change in diastolic blood pressure, total cholesterol, or LDL. Interestingly, HDL increased by 22% from 1 to 5 years following GB surgery ($P = 0.004$). Despite limited data on diabetes-related complications, microalbuminuria tended to improve, though this was largely driven by one subject. One subject had severe nonproliferative diabetic retinopathy (NPDR) at baseline, which improved to moderate NPDR at 1-year follow-up; moderate NPDR was unchanged in two subjects 1 year postoperatively.

We conclude that GB does not improve long-term glycemic control in severely obese women with type 1 diabetes. However, GB reduced body weight and improved several cardiometabolic risk factors for up to 5 years following surgery. The lack of sustained effect of GB on glycemic control in

individuals with type 1 diabetes is likely a consequence of their persistent absolute insulin requirement, resulting in periods of fasting hyperglycemia and increased variability of postprandial glucose excursions, as previously demonstrated in subjects with type 2 diabetes after GB (5). GB markedly alters patterns of early postprandial glycemia, contributing to a potential mismatch between nutrient absorption and prandial insulin timing.

Our study was limited by small sample size and single-sex cohort. Nevertheless, our evaluation of anthropometric, glycemic, and cardiometabolic outcomes at multiple time points following GB surgery in severely obese women with type 1 diabetes suggests that GB induces weight loss and improvement of some cardiovascular risk factors but does not improve long-term glycemic control in women with type 1 diabetes.

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Table 1—Anthropometric and cardiometabolic risk factors and glycemic control at baseline (*n* = 10) and at 1 (*n* = 10) and 5 (*n* = 7) years following GB surgery

	Baseline	1 year	<i>P</i> value†	5 years	<i>P</i> value‡	<i>P</i> value§
Weight (kg)	121.9 ± 22.1	81.9 ± 15.8	<0.0001**	93.6 ± 21.0	<0.0001**	<0.01*
BMI (kg/m ²)	43.5 ± 7.5	29.3 ± 5.4	<0.0001**	33.8 ± 7.5	<0.0001**	<0.01*
HbA _{1c} (%)	8.1 ± 1.3	8.3 ± 1.4	0.47	9.8 ± 1.9	0.15	0.26
HbA _{1c} (mmol/mol)	65 ± 14.2	67 ± 15.3	0.47	84 ± 20.8	0.15	0.26
Basal insulin (units/day)	53.0 ± 29.7	23.0 ± 15.6	0.0005**	31.1 ± 22.8	0.02*	0.17
Basal insulin (units/kg/day)	0.42 ± 0.19	0.27 ± 0.13	0.0005**	0.37 ± 0.17	0.0021*	0.174
Insulin pump, <i>n</i> (%)	6 (60)	6 (60)		5 (71)		
Multiple daily injections, <i>n</i> (%)	4 (40)	4 (40)		2 (29)		
Systolic blood pressure (mmHg)	123.6 ± 8.3	112.6 ± 11.3	0.003*	118.7 ± 14.1	0.45	0.19
Diastolic blood pressure (mmHg)	72.8 ± 8.3	69.7 ± 4.2	0.32	72.4 ± 7.2	0.97	0.57
HDL (g/dL)	61.5 ± 18.4	63.0 ± 11.8	0.8	80.5 ± 16.7	0.04*	0.004*
LDL (g/dL)	102.3 ± 20.4	92.8 ± 20.5	0.41	91.5 ± 26.3	0.44	0.95
Total cholesterol (g/dL)	185.4 ± 30.9	172.7 ± 24.2	0.59	195.3 ± 27.5	0.72	0.07
Triglycerides (g/dL)	112.8 ± 55.1	80.6 ± 43.6	0.004*	111.2 ± 109.5	0.12	0.29
Microalbumin (mg/L)	62.2 ± 142	21.5 ± 26.7	0.34	14.2 ± 16.3	0.29	0.07

Data are presented as mean ± SD, unless otherwise noted. †1 year compared with baseline. ‡5 years compared with baseline. §5 years compared with 1 year. *Significant at *P* < 0.05. **Significant at *P* < 0.001.

data and edited the manuscript. M.E.P. contributed to the discussion and edited the manuscript. F.M.B. analyzed the data and wrote the manuscript. F.M.B. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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